INFRA CLAVICULAR BRACHIAL PLEXUS BLOCK BY CORACOID APPROACH – A STUDY OF FIFTY CASES

DISSERTATION SUBMITTED FOR M.D. DEGREE EXAMINATION

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CERTIFICATE

This is to certify that **Dr. N.VIVEKANANDAN** has carried out all the work in connection with his thesis entitled

"INFRA CLAVICULAR BRACHIAL PLEXUS BLOCK BY CORACOID APPROACH- A STUDY OF FIFTY CASES"

at Thanjavur Medical College Hospital, Thanjavur and submitted for the partial fulfillment of M.D.Degree (Anaesthesiology) Examination to be held in March 2007.

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CONTENTS

Introduction

Regional anesthesia in general and nerve blocks in particular provide an ideal operative conditions when used optimally. They are said to cause least interference with the vital physiological functions of the body with reduced stress response, avoiding polypharmacy. Regional anaesthesia patients are alert, awake, and cooperative when compared to general anaesthesia.

Regional anesthesia traces its origin to Dr. Carl Koller, a young Viennese ophthalmologist who in 1884 employed a solution of cocaine for topical corneal anesthesia in patients undergoing eye surgery. This marked the start of a new era in medicine namely the use of regional anesthesia for the prevention of pain associated with surgery.

In 1884, William Halsted[1] performed the first regional blockade of brachial plexus. His technique involved surgical exposure of the plexus in the neck with subsequent intraneural blocking of individual nerves.

It was not until 1887, when George Crile[2] exposed the brachial plexus behind the sternocleidomastoid muscle to control the tetanic spasms in a young boy, that the block was used with some regularity

In 1911, the first percutancous approach to the brachial plexus was described by Hirschel. His axillary approach involved injection of local anaesthetics both below and above the axillary artery. Hirschel never considered placing the local anesthetic above the first rib by approaching the plexus from above the clavicle because he felt the possibility of pleural damage was too great.

In 1911, KulenKampff[3] in Germany described the first blind supraclavicular approach to block the brachial plexus, with mid point of the clavide and subclavian artery providing constant, easily identifiable land marks and because the first rib provided a safe back stop to limit the progress of needle. There are reports of complication particularly those of pulmonary damage, indicated that this approach was not without risk .

In 1916, Bazy[4] in France suggested an alternative that might preserve the advantages and overcome the disadvantages of classical supraclavicular. He advised to approach the plexus at a level that is higher than that of axillary approach to assure blockage of all nerves derived from the plexus, but lower than that of supraclavicular approach, to minimize the risk of pleural injury.

Minor modifications of Bazy's technique were proposed by Babilzki, Balog, and Kim. Their techniques were not intended to be replacements for Kulenkampff's techniques, but only as alternatives to be used when anatomical obstacles impair or prevent the easy and safe execution of the Kulenkampff method.

In 1973 Raj[5] reintroduced the infraclavicular approach to the brachial plexus. He introduced the needle more medially (just under the midpoint of the clavicle) and directed laterally from the point of entry. Thus, with this technique, there is no danger of pneumothorax, an advantage over supraclavicular and previously described infraclavicular techniques. Drug injected inside the brachial plexus sheath above the level of formation of musculo cutancous nerve and axillary nerve. Raj pointed out two additional advantages of his technique. Ulnar segment of medial cord is readily blocked which is an advantage over interscalene technique. Intercosto brachial nerve will also be blocked, no need for additional infiltration, an advantage over all techniques.

Raj considered that the axillary approach had certain limitations that the block can only be performed when the arm is abducted to 90^0 or more. It is difficult to block the musculocutaneous and axilliary nerve. Whenever a tourniquet is to be used, the intercostobrachial nerve has to be blocked by additional infiltration.

In 1977, Sims introduced a modification, in which the injection site is in the groove between the coracoid process of the scapula and the inferior border of the clavicle. With this technique, missing of musculocutaneous nerve and axillary nerve is very rare.

In 1981, Whiffler proposed a modification, in which the needle is inserted just inferior and medial to the coracoid process.

In 1998, Wilson et. al.[6] described a new technique in which the site of injection is 2cm medial and caudal to the coracoid process. The aim of their study was to use magnetic resonance imaging and cadaveric dissections to establish the orientation and depth of needle placement required to reach the brachial plexus by this coracoid approach.

The infraclavicular approach was developed in the hope to overcome these limitations.

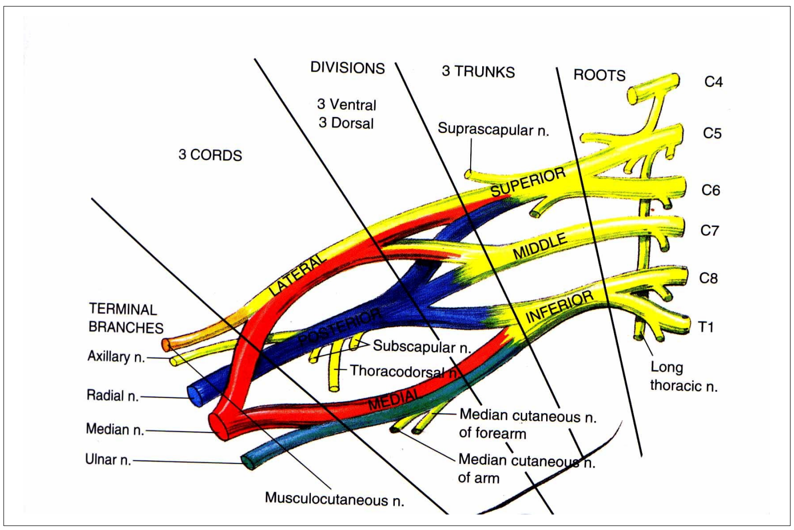
So this study was undertaken to evaluate the sensory distribution, motor block and the clinical efficacy of the infraclavicular block by the coracoid approach.

AIM OF THE STUDY

The aim of the present study is to evaluate the clinical efficacy of the infraclavicular block by coracoid approach, (Wilson's technique) and to evaluate the time to perform the block, onset time of sensory and motor blockade, quality of sensory and motor blockade, tourniquet tolerance time, duration of blockade and to study the side effects and complications.

BRACHIAL PLEXUS BLOCK-
ANATOMICAL CONSIDERATIONS

The brachial plexus provides the motor innervation and nearly all the sensory supply of the upper limb. Knowledge of the formation of the brachial plexus and of its distribution is absolutely essential to the intelligent and effective use of brachial plexus anesthesia for surgeries of the upper limb. Close familiarity with the vascular, muscular and facial relationships of the plexus throughout its formation and distribution is equally essential to the mastery of the various techniques of brachial plexus anesthesia.



Anatomy of brachial plexus

In its course from the intervertebral foramina to the upper arm, the fibres that constitute the plexus are composed consecutively of roots, trunks, divisions, cords and terminal nerves, which are formed through a complex process of combining, dividing. recombining and finally redividing.[7]

ROOTS:

These are anterior primary divisions of the lower four cervical and first thoracic nerves (C_5 – T_1). The fourth cervical nerve contributes to two-thirds of all the plexuses (prefixed brachial plexus) and the second thoracic nerve to more than one-third (post-fixed) of the plexuses. After emerging from the intervertebral foramina, roots pass behind the vertebral artery and travel laterally in the 'gutters' in the transverse processes of cervical vertebra. After emerging from the transverse processes, the roots converge toward the first rib between the anterior and middle scalene muscles. The plexus can be blocked at the level of the roots via interscalene approach.

TRUNKS:

Above the first rib, the five roots combine to form the three trunks of the brachial plexus. The trunks divide to form six divisions, three anterior and three posterior. The plexus can be blocked at the level of the trunks via the subclavian perivascular or traditional supraclavicular approach.

DIVISIONS:-

As the plexus emerges from behind the clavicle the divisions recombine to form three cords of the plexus. Since the divisions lie behind the clavicle they are not accessible to the needle. The plexus, therefore cannot be blocked at this level.

CORDS:-

The lateral cord is formed by the union of the anterior divisions of the superior and middle trunk, the medial cord is the continuation of anterior division of inferior trunk and all three posterior division combine to form posterior cord. The plexus can be blocked at the level of cords via infraclavicular approach.

ANATOMICAL RELATIONS OF BRACHIAL PLEXUS:-

Knowledge of the anatomical structures, which surrounds the brachial plexus, will help in location of the plexus as well as in the prevention of complications.

PERIVASCULAR COMPARTMENT:-

In the neck (above the clavicle) the plexus lies in the fascial compartment between middle and anterior scalene muscles. The fascia covering the scalene muscles is derived from the prevertebral fascia, which splits to enclose these muscles and joins at their lateral margins to form an enclosed interscalene space in which the brachial plexus lies. The roots and trunks of plexus are 'sandwiched' between the scalene muscles within the fascial compartment. The interscalene space is a potential space and therefore very narrow in its antero-posterior diameter. The nerve roots and trunks lies closer to the scalenus medius than to scalenus anterior muscle.

VASCULAR RELATIONSHIP:-

There are no major vessels at the level of the roots except for the vertebral vessels, which lie far medially anterior to the plexus. A long needle directed horizontally in the interscalene space may get into the vertebral artery or vein. The needle can also get into the subarachnoid or epidural space via interbertebral foramina. The trunks of the brachial plexus lie in close proximity to the subclavian artery, which separates them from scalenus anterior. This relationship of the trunks to the subclavian artery should be borne in mind when subclavian perivascular approach is being used. Entry into the artery would mean the needle is anterior to the plexus. Another anatomical fact of significance, is the inferior trunk of plexus may be trapped behind and under the artery. The artery in this situation will act as a mechanical barrier to the diffusion of local anesthetic solution injected higher in the interscalene space. The subclavian artery passes under the clavicle along with the plexus into the axilla where it becomes the axillary artery. Above the clavicle the artery lies in front of the plexus while in the axilla the artery lies central to three cords.

SYMPATHEITC FIBERS:-

The cervical sympathetic chain is separated from the roots and trunks of the plexus by the prevertebral fascia. Since the fascia is not 'water tight', the local anesthetic diffuses through the fascial barrier to block the sympathetic chain resulting in ipsilateral Horner's syndrome in about 60.75% of patients undergoing brachial plexus block above the clavicle .

PHRENIC NERVE:-

The phrenic nerve originates from the 3rd , 4th , and 5th cervical nerve roots after its formation passes down the anterior surface of the scalenus anterior. The phrenic nerve is separated from the plexus by the scalenus anterior and its posterior fascial investment. Phrenic nerve block with hemidiaphargm dysfunction occurs in 100% of patients receiving interscalene block and in 30-50% of patients receiving supraclavicular block. Therefore the option of brachial plexus block above the clavicle should not be offered to the patients with pulmonary dysfunction like bronchial asthma.

RECURRENT LARYNGEAL NERVE:-

The right recurrent laryngeal nerve is in close relation to the first part of the subclavian artery, therefore, it lies in a closer relation to the brachial plexus than the left recurrent laryngeal nerve. Recurrent laryngeal nerve block with hoarseness occurs in 30-40% of the patients receiving interscalene block.

A summary of formation of brachial plexus at different levels and its major terminal branches is presented below. [8]

The upper trunk is formed by anterior rami of C_5 and C_6.

The middle trunk is formed by anterior ramus of C_7.

The lower trunk is formed by the anterior rami of C_8 and T_1

Behind the clavicle the trunks each divide into anterior and posterior divisions.

The posterior cord is formed by three posterior divisions.

The medial cord is formed by the lowest anterior divisions

The lateral cord is formed by the upper two anterior divisions.

BRANCHES:-

Are given off from

Roots

Trunks

Cords

BRANCHES FROM THE ROOTS.

Nerve to serratus anterior (of Bell) – C_5,C_6 and C_7 .

Muscular branches to

Longus cervicis	(C_5 – C_8)
Three Scaleni	(C_5 – C_8)
Rhomboids	(C_5)

A twig to phrenic nerve.

BRANCHES FROM THE TRUNKS

Suprascapular nerve	(C_5 – C_6)
Nerve to subclavius	(C_5 – C_6)

BRANCHES FROM CORDS

LATERAL CORD

Lateral pectoral nerve	(C_5 – C_7)
Lateral head of median nerve	(C_5 – C_7)
Musculocutaneous nerve	(C_5 – C_7)

POSTERIOR CORD

Radial nerve	(C_5 – T_1)

Axillary nerve	($C_5 – C_6$)
Thoraco dorsal nerve	($C_5 – C_8$)
Upper and lower subscapular nerve	($C_5 – C_6$)

MEDIAL CORD

Medial head of median nerve	($C_8 – T_1$)
Medial pectoral nerve	($C_8 – T_1$)
Ulnar nerve	($C_8 – T_1$)
Medial cutaneous nerve of forearm	($C_8 – T_1$)
Medial cutaneous nerve of arm	(T_1)

REGIONAL ANATOMY FOR INFRACLAVICULAR BLOCK:-

In the infraclavicular region the plexus lies directly inferior to the lateral third of clavicle, posterior to pectoralis major and minor muscles and medial to the coracoid process. At this location, the plexus primarily comprises of cords which are starting to give off terminal nerves. Brachial plexus, therefore, has the greatest variability and complexity at this site.

The boundaries of the infraclavicular fossa are pectoralis minor and major muscles anteriorly, ribs medially, clavicle and the coracoid process superiorly and humerus laterally. With infraclavicular approach, brachial plexus is approached at the level of the cords in the infraclavicular fossa in proximity to the coracoid process. The sheath surrounding the plexus is delicate. It contains the subclavian artery, axillary artery and vein. Axillary and musculocutaneous nerve leave the sheath at or before the coracoid process in 50% of patients.

PHYSIOLOGY OF NERVE CONDUCTION

Electrical potentials exist across the membranes of essentially all cells of the body. Some cells such as nerve and muscle cells are “excitable”, that is capable of self generation of electro-chemical impulses at their membranes and employ these impulses to transmit signals along the membranes.[9]

The neural membrane is able to maintain a voltage difference of 60 to 90mv between its inner and outer aspects because at rest it is relatively impermeable to sodium ions but selectively permeable to potassium ions. This is maintained by Na^+/K^+ – pump.

At any given moment of time, any given point on an axon is in one of three states, it may be resting, it may be actively involved in electrical signal propagation, or it may be refractory. [10,11]

The active energy dependent Na^+/K^+ pump, sustains the ion gradient that drive this potential difference by constant extrusion of sodium with in the cell in exchange for a net uptake of potassium by using adenosine triphosphate as an energy source. Although the membrane is relatively permeable to potassium ion an intracellular-to extracellular potassium ratio of 150 to 5mM or 30:1[12] is maintained. The nerve at rest behaves largely as a "potassium electrode".

The mechanism by which a nerve cell transmits electrical signals is known as action potential. During an action potential the nerve membrane transiently switches its permeability from K^+ selective to Na^+ selective, thus changing the membrane potential from negative to positive and back again.

Ion permeation through membrane occurs by means of special proteins called ion channels. The conformation of these channels is often sensitive to the membrane potential; both Na^+ and K^+ channels in nerve membranes are activated to open conformation by membrane depolarization. A small membrane depolarization will open both Na^+ and K^+-channels. The Na^+ - channels open faster, and the inwardly directed Na^+ - current is larger, Sodium ions thus entering the nerve depolarize it further, which leads to the opening of more Na^+ - channels and thereby increases the current even further.

This sequence of events continues in the positive feed back of depolarizing phase until some of the Na^+ channels becomes inactivated. Net sodium transport decreases dramatically. At this point, a less rapid but more sustained change occurs in the permeability of the cell to the passage of potassium ion. Potassium flows along its concentration gradient from inside to outside of the cell, taking positive charge with it.

The loss of positive ions from inside the cell causes a fall in the electrical potential of the axoplasm below neutral. The change in potassium conductance is sustained for sufficient time for the net potential difference across the membrane to reach –75mv, some what below the resting membrane potential.

This hyperpolarization combined with the inactive sodium ion channel, is responsible for the brief refractory period that each segment of neuron is required to undergo following generation of an action potential.

Owing to the myelin sheath, myelinated axons are able to transmit an action potential more rapidly than unmyelinated axons.[12] Depolarization at a node of Ranvier results in the transmission of the change in potential difference directly to the next node of Ranvier along the nerve without having to depolarize all the axolemma in between. This has two advantages, namely that impulse conduction occurs more rapidly and that less energy is required.

APPLIED PHARMACOLOGY :- [14]

Nerve fibres has two types of bundles functionally. The central fibers are called core fibers and the fibers in the periphery are called mantle fibers. The mantle fibres which contain outer motor fibres and inner sensory fibres which has its innervation to the arm. The core fibres with the peripheral fibres being motor and supplying the muscles of the forearm and the most central fibres carrying sensation from the hand. When local anesthetic is injected around a nerve trunk, the onset of block in the arm is as follows, loss of motor power to the shoulder and upper arm, loss of sensation in the upper arm, loss of motor power of the fore arm and loss of sensation to the hand.

PHARMACOLOGY OF BUPIVACINE

Bupivacine[13] is an amide local anesthetic characterized as pipecoloxylidides. Addition of a butyl group to the piperidine nitrogen of mepivacine results in bupivacine. It is a chiral drug because of possession of asymmetric carbon atom.

It was first synthesized in Sweden by EKENSTM and his colleagues in 1957 and used clinically by L.J TELIVOO in 1963. It is commercially available as the hydrochloric acid.

PHAMACOKINETICS :-

It is a weak base that has pKa value above physiologic pH. At pH 7.4 only 15% exists in non ionised form. Absorption depends on the site of injection and dosage. Lung is capable of extracting bupivacine from circulation, which will limit concentration of drug that reaches systemic circulation. This first pass pulmonary extraction is dose dependent suggesting that it becomes saturated rapidly.

pKa	- 8.2
Non ionized fraction at Physiological pH	- 15%

Protein binding	- 95%
Lipid solubility	- 28
Volume of distribution	- 73litres
Clearance of the drug from plasma	- 0.47lit/min
Distribution half life $t_{½}$ (α)	- 2.7min
$t_{½}$ (β)	- 28 min
Elimination half life	- 210 min
Maximum single dose for infiltration in adults	-175 mg
Duration of action following infiltration	-5-16 hrs
Onset of action	- 15 – 20min
Maximum dose	- 3mg/kg with or without adrenaline
Toxic plasma concentration threshold	- 1.6 – 2 /µgm/m1

Note: addition of adrenaline to bupivacine has no effect on its duration of action except that it delays absorption of local anesthetics due to vasoconstriction from the site of administration

Metabolism

Slowest metabolism among amide local anesthetics. It undergoes aromatic hydroxylation, N-dealkylation, amide hydrolysis and conjugation. Only the N. desbutyl bupivacine has been measured in blood or urine after epidural or spinal anesthesia. Alpha –1 acid glycoprotein is the most important protein binding site of bupivacine.

Concentration used

Infiltration	-	0.125 – 0.25 %.
Peripheral nerve block	-	0.25-0.5%
Surgical/obstetric epidural	-	0.125-0.75%
Spinal	-	0.5% heavy.

Side effects.

Bupivacine is more cardiotoxic than equieffective doses of Lignocaine. This is manifested by severe Ventricular arrhythmias and myocardial depression. Bupivacine blocks cardiac Na^+ - channels rapidly during systole and dissociates more slowly during diastole, so that a significant fraction of Na^+ - channels remain blocked at the end of diastole. Thus the block by bupivacine is cumulative and substantially greater.

Clinical use :

Onset of anesthesia and duration of action are long. Its tendency to provide more sensory than motor block has made it popular for providing post operative analgesia. It is mainly used for infiltration anesthesia, field block anesthesia, nerve block anesthesia, spinal anesthesia and epidural anesthesia.

MATERIALS AND METHODS

STUDY DESIGN:

Prospective descriptive study

SeLection of cases :-

This study was conducted at Thanjavur Medical College Hospital, Thanjavur during the period of July 2005 and September 2006. After institutional ethical committee clearance and after obtaining informed consent, 50 ASA grade I and II patients, who were scheduled for elective or emergency surgical procedures of hand, wrist, forearm or elbow surgeries were included in the study. All patients underwent a thorough pre anesthetic evaluation to ascertain medical and physical fitness.

EXCLUSION CRITERA :-

- Age younger than 14 yrs
- Infection at the site of puncture
- Any history of coagulopathies
- Any history of allergy to amide local anesthetics
- Old fracture of clavicle with malunion
- Patients who are ASA grade III or IV.

MATERIALS :-

Various equipments necessary for the block were kept ready in the operation theatre such as, sterile tray for regional blocks, drugs for the block, equipments for resuscitation, drugs for resuscitation Fisher and Paykel nerve locator with electrodes.

METHODS:-

PREPARATION:

In the operation theatre after recording the vital signs – pulse rate, blood pressure and respiratory rate, an intravenous infusion was started using an 18G cannula. ECG, oxygen saturation (Pulse oximetry) and non- invasive blood pressures were monitored and recordings were set at every 2 minutes intervals for 15 minutes and every 15 minute intervals there after.

All patients included in the study were premedicated with Injection midazolam 1-2mg IV (0.1mg/kg) and the dose titrated depending on the patients age, weight and degree of anxiety.

The peripheral nerve locator (by Fisher and Paykel health care) is kept ready and an ECG surface electrode was applied in the manubrium sterni area, anode of the locator is attached to the surface electrode, cathode is attached to 100mm, 21- gauge insulated short bevel stimulating needle (stimuplex A, Braun Meisurgen AG). The neck was prepared with surgical spirit and draped with sterile towels.

TECHNIQUE:- [6,15,16]

The block was performed with the patient lying supine with his head turned to the direction opposite the limb to be anesthetised. The arm to be blocked laid in a neutral position, along the body. Coracoid process is identified by palpation and a point is marked, 2cm caudal and 2cm medial to the coracoid process. Whenever there is difficulty in identifying the coracoid process, we asked the patients to shrug the shoulder, the coracoid process is felt when the head of humerus is positioned in the upward direction. At that point, stop clock was started to determine the time required to perform the block.

Using a sterile technique, Braun 100mm insulated short-bevel stimulating needle was inserted at that marked point perpendicular to the skin and connected to a nerve stimulator that was programmed with the following variables, current 2.0mA and frequency 1 Hz. The needle was advanced with the knowledge that the plexus would be at about 4 cm of depth. A twitch of the pectoralis muscle is observed first and indicates a too shallow placement of needle. As contractions of the pectoralis muscle cease, the needle is slowly advanced, until the twitches of the brachial plexus are elicited. The ideal end point for local anesthetic injection is elicitation of wrist flexion and extension or finger flexion and extension. When this desired evoked motor responses are elicited, the strength of the current is gradually decreased to 0.2mA, if the same responses are present even at 0.2mA, the 0.375% bupivacine solution of 40ml[20] is injected after negative aspiration. At that point stop clock was stopped and the time noted down.

In the absence of an upper extremity motor response, the needle was redirected cephalad or caudad but never medially to avoid the pleura.[17] When these maneuvers fail to result in motor response, we withdraw the needle and assessed the land marks once again. Twitches from the biceps or deltoid muscles were not accepted as an end point of injection, since the musculocutaneous nerve and axillary nerve, respectively may depart the brachial sheath before the coracoid process.

EVALUATION OF BLOCK :-

Evaluation of degree of blockade is done by Hollmen's Scale.

HOLLMEN'S SCALE :-[18]

SENSORY BLOCKADE :

O – Normal sensation of pin prick.

+ – Pin prick felt as sharp pointed but weaker compared with the same area in the upper extremity.

++ – Pin prick recognized as touch with a blunt object

+++ – No perception of touch

MOTOR BLOCKADE :

0 – Normal muscle function.

+ – Slight depression in muscle function as compared with pre anesthetic power.

++ – Very weak muscular action persisting in muscle .

+++ – complete block

We numbered the Hollmen's scale as follows for easier documentation 0(1), + (2), ++ (3), +++(4).

The following nerves were studied

SENSORY NERVES :-

Axillary nerve

Musculocutaneous nerve

Radial nerve

Median nerve

Ulnar nerve

Medial cutaneous nerve of the arm

Medial cutaneous nerve of the forearm

MOTOR NERVES:-

Median nerve

Ulnar nerve

Radial nerve

Musculo cutaneous nerve

PARAMETERS STUDIED :-

Time taken to perform a block

It is the time in minutes from the time the insulated Braun needle is inserted till the local anesthetic solution injected.

ANALGESIA

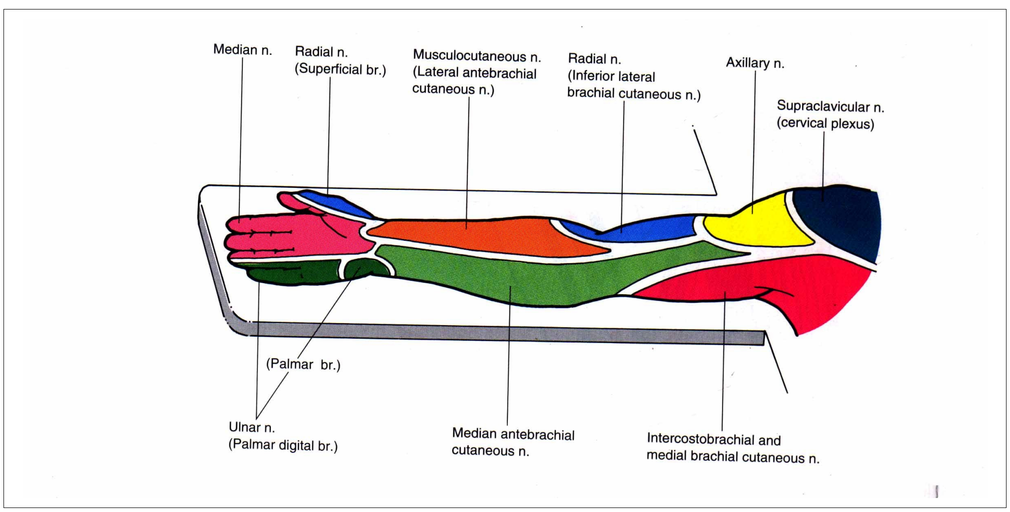
The time in minutes from the injection to the lack of appreciation of pin prick. This was checked every minute for the first five minutes and every two minutes from the sixth minute upto twenty minutes.

MOTOR ONSET

It is the time in minutes from the drug injection to the inability to move the limbs. This was assessed every minute for the first five minutes and every two minutes from the sixth minute upto twenty minute. This was checked by asking the patients to flex and extend the elbow and by checking the movements of thumb and little finger.

EXTENT :-

The extent of analgesia to pin prick was checked in the dermatomal distribution in an orderly manner. The efficacy was studied by using Hollmen's scale.



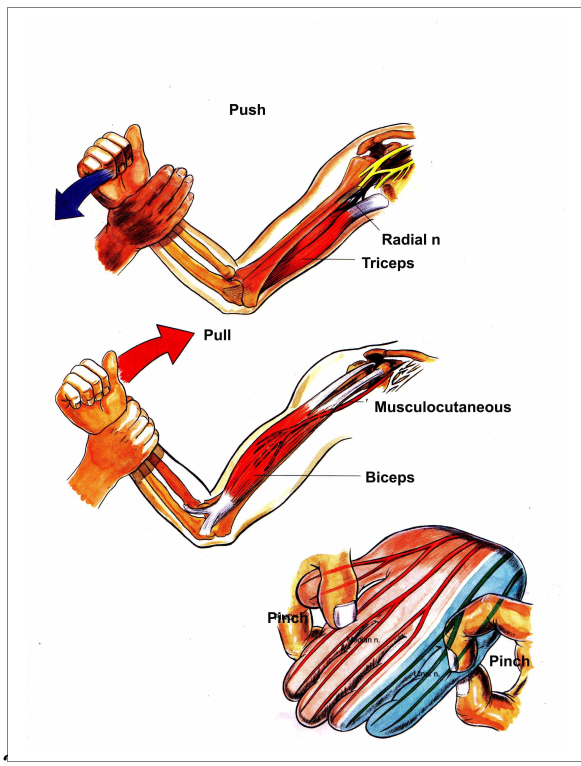
Sensory dermatomal distribution

DURATION:

All the patients were asked to note when they feel again the pain in the post operative period. The duration of analgesia measured was the time in minutes from the onset of analgesia to the recurrence of pain.

MOTOR EFFECTS:

An assessment of motor blockade of various groups of muscles 15 minutes after the injection was graded using Hollmen's scale.



Testing of Motor function

In adeq al aneasthesia . No intravenous sedatives or analgesics were given.

COMPLICATIONS

An assessment of the various complications such as intravascular injections, pneumothorax, systemic toxicity of local anesthetics were made

Pneumothorax is looked for injection of drugs by auscultation every fifteen minutes peroperatively and for every one hour upto six hours post operatively

Most of the procedures were done with a tourniquet. Tourniquet pain, tourniquet tolerance time were noted.

OBSERVATIONS AND RESULTS

Fifty patients posted for elbow or below elbow surgeries who were admitted in Thanjavur Medical College Hospital of Physical Status ASA I and II were taken up for the study.

PHYSICAL CHARACTERISTICS:-

AGE DISITIBUTION:

The minimum age group in this study is 20 years and the maximum age is 70 years. The mean age group is 36.38 years.

AGE GROUP	STUDY GROUP
RANGE	20 – 70 Years
MEAN	36.38

Age group range (in Years)	No. of Patients
20 - 30	18

31 – 40	17
41 - 50	3
51 - 60	10
61 – 70	2

WEIGHT DISTRIBUTION

The weight of the patients in the study group ranges from 50kg to 65kg. Twenty four patients were between 50 to 55 kg, twenty three patients were between 56kg to 60 kg. Three patients were between 61kg to 65kg.

WEIGHT RANGE	NO. OF PATIENTS
50 – 55 kg	24
56 –60 kg	23
61 – 65 kg	3

SEX DISTRIBUTION:

Of the fifty patients, number of male patients in this study group was 36 and the number of female patients was 14

	MALES	FEMALES
STUDY GROUP	36	14

TYPES OF SURGICAL PROCEDURES :-

A variety of surgical procedures involving elbow, forearm and hand were performed. Twenty eight patients were forearm surgeries and in sixteen patients hand surgeries were performed. In six patients surgeries involving elbow were done.

SURGICAL PROCEDURES	NO. OF PATIENTS
FOREARM	28
HAND	16
ELBOW	6

TIME TO PERFORM THE BLOCK

Mean time to perform the block was noted down. It is the time taken from the start of insertion of needle to the end of drug injection. It was found to be 7.2min (with SD ±2.64).

SENSORY ONSET

In this study group, the onset of analgesia ranged between 14 min to 22 min. The mean value is 17.93 min.

SENSORY ONSET	STUDY GROUP
RANGE	14 min – 22 min
MEAN	17.93
STANDARD DEVIATION	±1.60

Sensory onset range (in mts)	No. of Patients
14	1
15	6
16	2
17	12
18	18
19	1
20	5
21	-
22	1

MOTOR ONSET:

Motor onset time in the study group was noted. It ranges from 9 min to 16 min with mean duration of 12.54 min

MOTOR ONSET	STUDY GROUP
RANGE	9 min to 16 min
MEAN	12.54 min
STANDARD DEVIATION	±1.53

Motor onset range (in mts)	No. of Patients
9	1
10	5
11	4
12	10
13	15
14	7
15	3
16	1

DURATION OF ANALGESIA:-

Duration of sensory block was observed in the post operative ward. Its duration ranged between 240 min to 310 min with a mean value of about 285.69 min.

DURATION OF SENSORY BLOCK	**STUDY GROUP**
RANGE	240 min – 310 min
MEAN	285.69 min
STANDARD DEVIATION	±13.72

Range of duration of sensory block (in mts)	**No. of Patients**
240-250	1
251-260-	2
261-270	3
271-280	9
281-290	13
291-300	15
301-310	3

TOURNIQUET TOLERANCE TIME

An arm tourniquet (esmarch bandage) was applied in 30 out of 50 patients. Tourniquet was tolerated in all patients throughout the duration of surgery with out the need for additional analgesics.

SENSORY BLOCKADE:-

The results of the degree of blockade of the major sensory nerves were assessed. Success rate defined as analgesia in the five nerves distal to the elbow (musculocutaneous, median ulnar , radial and medial cutaneous nerve of the forearm) was 92%. Assessment of blockade of axillary nerve and medial cutaneous nerve of arm were observed only in patients where tourniquet was applied (30 Patients). A proximal block of the axillary nerve was present in 96.66% of the patients and of the medial cutaneous nerve of arm 60% of the patients.

HOLLMEN'S SCALE

SNO	NERVE	DEGREE OF BLOCKADE	STUDY GROUP
1.	MUSCULOCUTANEOUS	O + ++ +++	1 3 0 46
2.	MEDIAN	0	4

		+ ++ +++	0 6 40
3.	ULNAR	0 + ++ +++	4 0 2 44
4.	RADIAL	0 + ++ +++	3 1 8 38
5.	MEDIAL CUTANEOUS NERVE OF FOREARM	0 + ++ +++	3 1 2 44
6.	AXILLARY	0 + ++ +++	1 0 2 27
7.	MEDIAL CUTANEOUS NERVE OF ARM	0 + ++ +++	10 2 3 15

MOTOR BLOCKADE:

The results of the degree of motor blockade of median nerve, ulnar nerve, radial nerve, and musculo cutaneous nerve were assessed based on Hollmen's scale. 94% of patients had adequate motor blockade.

SNO	NERVE	DEGREE	STUDY GROUP
1	MUSCULOCUTANEOUS	0 + ++	0 3 0

		+++	47
2	MEDIAN	0 + ++ +++	2 1 2 47
3.	ULNAR	0 + ++ +++	1 2 1 46
4.	RADIAL NERVE	0 + ++ +++	3 0 3 44

COMPLICATIONS:-

In the study group, we have looked at the incidence of various complications such as accidental venous puncture, pneumothorax, and systemic toxicity of local anesthetics. None of the patients in the study group showed any complications.

REVIEW OF LITERATURE

DELUEZE A, GENTILL ME et al[19] in their study on one hundred patients have shown that a single stimulation of infraclavicular brachial plexus block by coracoid approach is safe and easier to perform than the multiple stimulation axillary block

Brachial plexus block performed via the infraclavicular coracoid approach is as safe and effective as the axillary approach with all the blocks were performed with a total dose of 40 ml of 0.375% Bupivacine. Infraclavicular block by coracoid approach may be preferred to the axillary approach when the upper arm mobility is impaired or not desired. As per the experience of **ERTUG Z. YEGEN A et al**[20] in a group of thirty patients**.**

Coracoid block when compared with the supraclavicular approach pulmonary complications do not occur and compared with the axillary approach a higher level of analgesia can be obtained and a potentially septic area is not traversed. This was observed by **ROUSO AND K. WHIFFLER.**[21]

Axillary block is devoid of severe respiratory complications, however incomplete anesthesia of the upper limb is the main disadvantage of the technique. Theoretically the infraclavicular approach by coracoid approach produces an more extensive block without the risk of pneumothorax as per the experience of **RODRIGUEZ J. BARCENAM et al**[25] in their prospective study of twenty patients.

Based on the safe landmark and feasibility of the lateral infraclavicular block, this technique has to be reconsidered in clinical practice – **KAPRAL S. JANDRASITS O. et al**[23] have concluded in their study group of forty patients.

The technique of coracoid block is a safe and easily performed method for regional anesthesia routinely applied in planned, urgent and out patient surgery of upper extremity **KOSTADINOVA – R et al**. [24]

Local anesthetic injection after elicitation of a distal motor response with a nerve stimulator is believed to produce a more clinically efficient infraclavicular coracoid block than after elicitation of proximal motor response. This was observed by **RODRIQUEZ J, TABOADA et al**[22] in a randomized prospective single blinded study of one hundred and thirty patients.

KLAASTAD et al[26] – The infraclavicular brachial plexus block first described by **RAJ et al** was supposed to anesthetize all the main peripheral nerves of the brachial plexus with out the risk of pneumothorax. In performing the block we had difficulties in finding the nerves at the cord level. Using a MRI scanner, the anatomical basis of Raj infraclavicular method for brachial plexus blockade was examined in ten volunteers. The results showed that the method should be modified to make it more precise and to provide less risk of complication.

WILSON et al[6] in a study group of forty patients used a coracoid approach to infraclavicular block to create an easily understood technique. **WILSION et al** sought a consistent palpable landmark for facilitation of infraclavicular brachial plexus block.

They used MRI images of brachial plexus to determine the depth and needle orientation needed to contact the brachial plexus.

KILKA H.G. et al[27] demonstrated a prospective clinical study in one hundred and seventy five patients that the Infraclavicular vertical brachial plexus blockade represents a highly successful method compared to other common techniques. Tolerance of the upper arm tourniquet for longer periods also demonstrated by **KILKA et al**.

MINVILLE V. AMATHIEU R et al[28] have shown that the time to perform the infraclavicular brachial plexus block by coracoid blocks was 9.8 minutes and the onset time was 15 minutes and the success rate was 92%. They have demonstrated in their study on one hundred and two patients.

ANN Fr et al[29] based on their studies in one hundred patients have demonstrated that the Infraclavicular brachial plexus success rate was 92% based on sensory and motor distribution. No patient required general anesthesia conversion.

Single injection infraclavicular block, using a vertical paracoracoid approach appears suitable for surgery distal to the elbow. The success rate was 89% with out the need for additional peripheral nerve block or general anesthesia – **JANDARD C. GENTILI ME, et al.**[30]

ADAM et al[31] conducted a study in eighty eight patients who under went surgeries below elbow. They found that vertical infraclavicular blockade of the brachial plexus has high success rate and low risks. Success rate was around 85%.

MITCHELL T. KESCHSNER et al[32] conducted a study regarding the safety and efficacy of the infraclavicular nerve block performed at low current. They found out that the peripheral nerve or plexus blocks performed with the use of a nerve stimulator at low, current $\leq$ 0.3 mA results in nil incidence of neurologic complications in the post operative period.

DISCUSSION

This prospective study was conducted to assess the efficacy of the infraclavicular block by coracoid approach. This approach to the brachial plexus block has gained popularity because of the greater percentage of satisfactory analgesia for upper extremity surgery.

Several favourable characteristics of this coracoid approach can be highlighted. Contrary to the axillary block, the arm to be anesthetized does not need to be in a 90^0 elbow flexion. Arm positioning is thus less painful for patients with fractures. The technique relies on the identification of the coracoid process, an easily palpable land mark even in obese patients.

The single injection coracoid infraclavicular block is time efficient. It takes an average of 7.2 minutes to execute. This correlated well with the study conducted by **MINVILLE V et al**[28] which reported a mean duration 9.8 minutes. This time is shorter than that reported for the axillary multiple injection technique which is about ten minutes according to a study conducted by **KOSCIELNIAK – NIELSEN et al.**[33]

In our study the coracoid block gives excellent result with 92% of patients having analgesia of the five terminal nerves distal to the elbow. This correlated well with the study conducted by **JEAN DESROCHES**[34] which reported a 91% success rate.

The criterion of block success used in our study is more stringent. In our study success rate is defined as analgesia in the five nerves distal to the elbow (musculocutaneous, median, ulnar, radial, medial cutaneous nerve of the forearm). In other studies conducted by **RODRIGUEZ et al**,[25] block success is defined as the block of two terminal nerves.

In this study 94% patients showed a high degree of motor blockade, which correlated well with the study conducted by **JEAN DESROCHES et al.**[34]

The onset of analgesia in this study group is 17.93 min. This correlates with the study conducted by **MINVILLE V AMATHIEU R et al.**[28] The onset of motor blockade ranged between 9 min to 16 min with a mean duration of 12.54 min. The duration of the analgesia observed in the post operative period ranged between 240 min to 310 min with a mean duration of about 285.69 min.

For surgeries distal to the elbow, the axillary approach is still the most widely used technique for brachial plexus block but for axillary approach stimulation of multiple nerves seems to offer the best results as suggested by **BENHAMOU. D et al**.[35] Many patients still complained of tourniquet pain with multiple injection axillary approach.

The infraclavicular block by coracoid approach described in this study makes it possible to tolerate the arm tourniquet with out the need of additional sc infiltration or IV sedation. In our study of forty six patients with a successful block. 30 patients had an arm tourniquet applied (65%) and none complained of tourniquet pain. Tourniquet was tolerated for a duration of 34.4 min throughout the duration of surgery. Axillary nerve block is seen in 96.66% of the patients. Proximal extension of the block was partial with a frequent sparing of the medial cutaneous nerve of the arm (60%), even so the tourniquet was tolerated in all the thirty patients.

This correlated well with the study conducted by **JEAN DESROCHES et al.** [34] which reported tourniquet tolerance time of 37±21 min (mean ± SD), with 98.5% showing block involving axillary nerve and the medialcutaneous nerve of the arm in 60% of the patients.

In this study four unsuccessful blocks occurred which was converted into general anesthesia.

Many of the failures occurred in the infraclavicular block by coracoid approach is due to acceptance of proximal motor response as the end point of injection. This was also observed by **RODRIQUEZ J, TABOADA et al.**[22] in their study. Main cause of failures in their study group is due to acceptance of forearm flexion as an end point of injection.

Many different types of infraclavicular approaches varies depending upon the puncture site and needle direction, so incidence of complications also differs. In this study we never encountered a single complication and the incidence is zero. This was supported by the study of **KLAASTAD O. et al.**[26]

CONCLUSION

In the light of the findings of the present study, the infraclavicular block by the coracoid approach provides highly consistent brachial plexus anesthesia for the upper extremity surgery. Several favourable characteristics of this infraclavicular approach was highlighted in this study such as

- The mean time to perform the block was shorter
- The arm to be anesthetized can be kept in a neutral position, while performing the block.
- Easy identification of coracoid process
- Tourniquet was tolerated in all patients.
- No Incidence of complications.

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